

# Best Practice Information Aids for CMMI<sup>SM</sup>-Compliant Process Engineering

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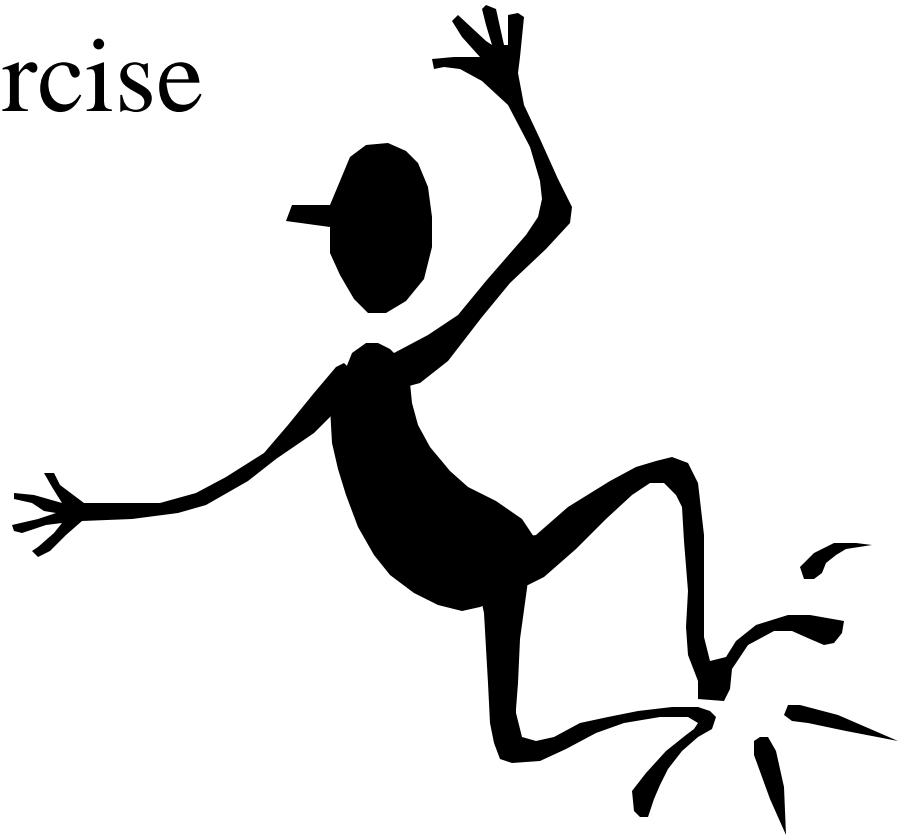
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Committee*

*Convener, ISO/IEC JTC1/SC7 WG9*

Computer Sciences Corporation

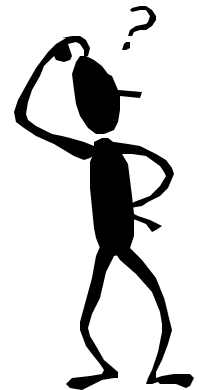
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# A Preparatory Exercise



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How many of you know that there  
are two **Framework Standards**  
for  
**System and Software**  
**Life Cycle Processes?**



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How many of you know that there  
are forty+ **Supporting Standards**  
for  
**Software and Systems**  
**Process Engineering?**



- Standards As Sources of Best Practice Information
- The CMMI<sup>SM</sup> As A Process Framework Model
- Process Framework Standards
- Best Practice Support for Life Cycle Frameworks
- Applying Best Practices in the CMMI<sup>SM</sup> Context
- Next Steps



# Standards As Sources of Best Practice Information

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Standards, are **consensus-based** documents that **codify best practice**. Consensus-based standards have seven essential attributes that aid in process engineering. They:

- represent the **collected experience** of others who have been down the same road,
- tell in **detail what it means to perform** a certain activity,
- can be attached to or referenced by contracts,
- help to assure that **two parties have the same meaning for an engineering activity**,
- increase professional discipline,
- **protect the business and the buyer**,
- **improve the product**.



# The CMMI<sup>SM</sup> As A Process Framework Model

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- Contains the essential **elements of effective processes** for one or more disciplines
- Contains a **framework** that provides the ability to generate multiple models and associated training and assessment materials. These models may represent:
  - ◆ software and systems engineering
  - ◆ integrated product and process development
  - ◆ new disciplines
  - ◆ combinations of disciplines
- Provides **guidance** to use when developing processes



# What The CMMI<sup>SM</sup> Is Not

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- CMMI models are **not processes** or process descriptions. Actual processes depend on:
  - ◆ Application domain(s)
  - ◆ Organization structure
  - ◆ Organization size
  - ◆ Organization culture
  - ◆ Customer requirements or constraints





# Process Framework Standards

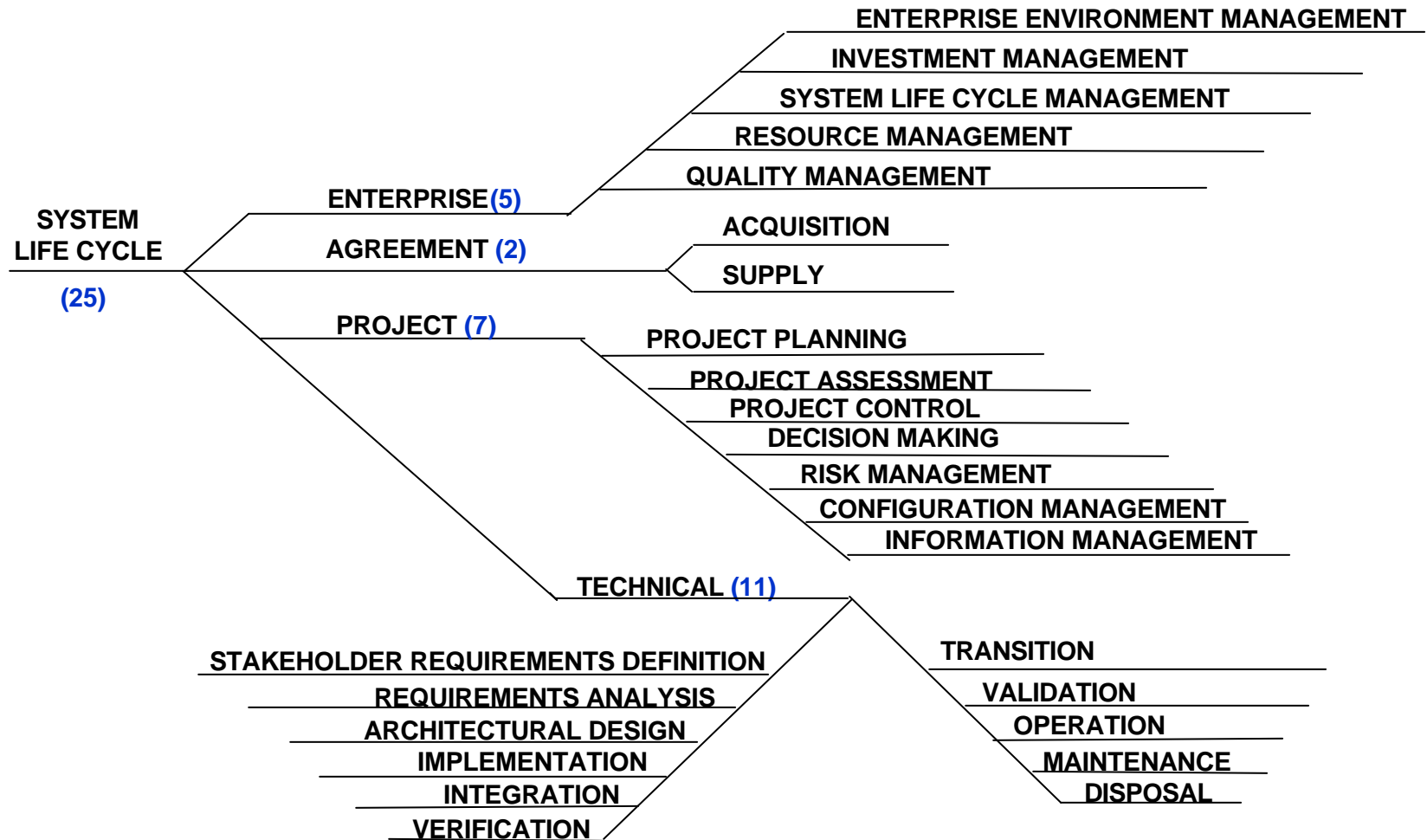
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- Systems Life Cycle
  - ◆ ISO/IEC 15288
- Software Life Cycle
  - ◆ ISO/IEC 12207
  - ◆ IEEE/EIA 12207.0, 12207.1, 12207.2
- Process Assessment
  - ◆ ISO/IEC 15504

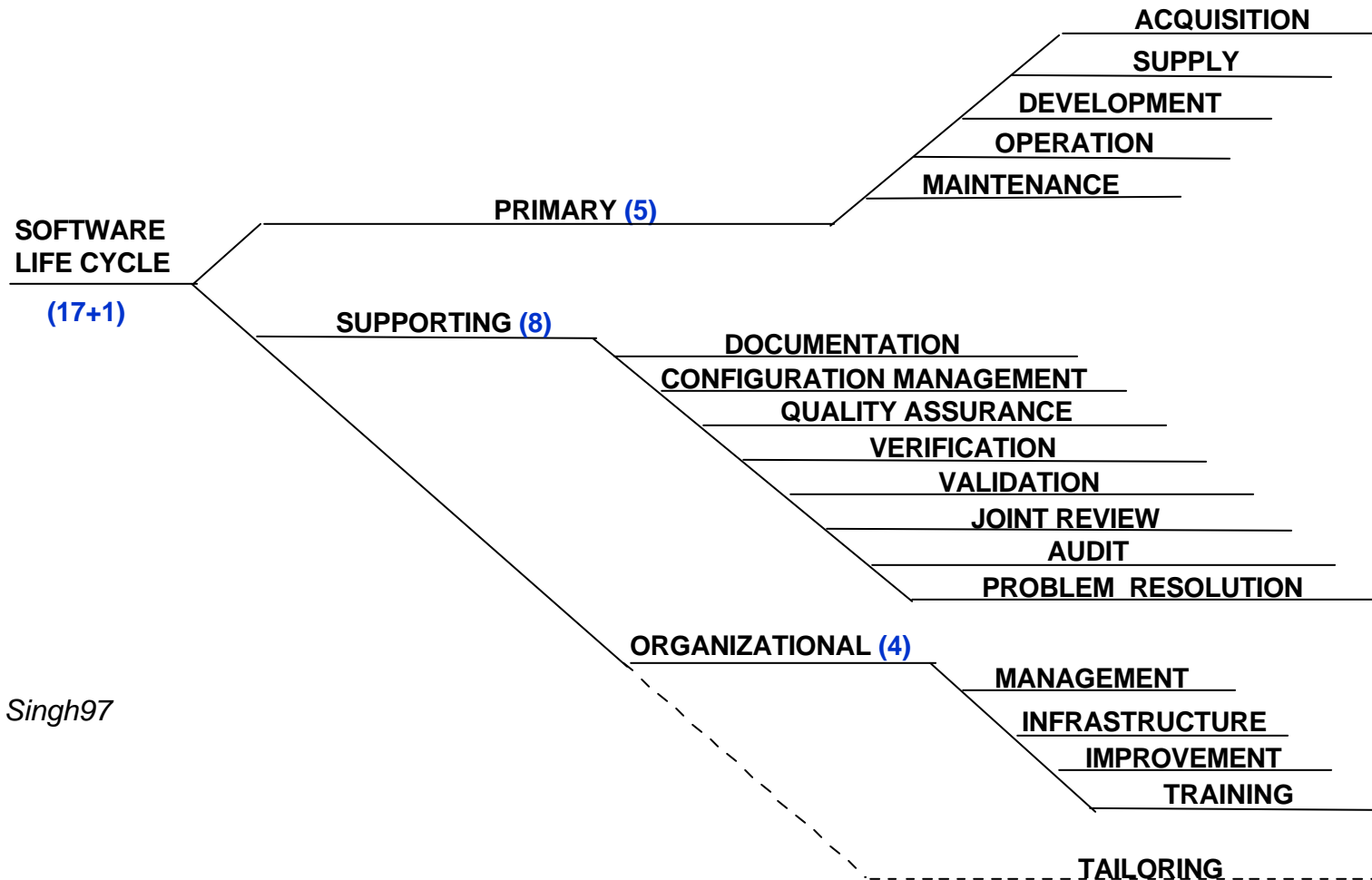


# The ISO/IEC 15288 Systems Life Cycle Process Framework

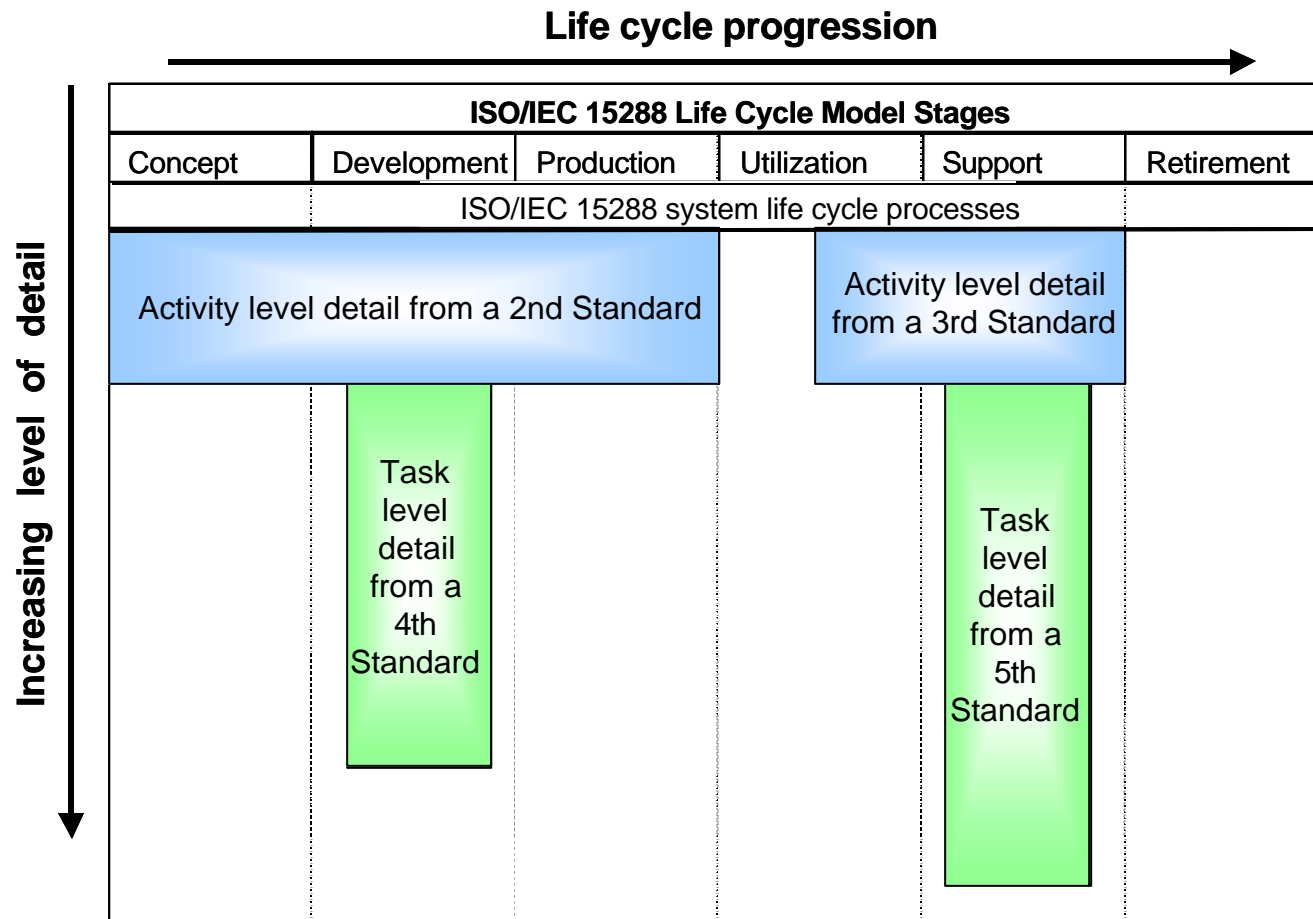




# The IEEE/EIA 12207 Software Life Cycle Process Framework



Source: Singh97



## A1 - ISO/IEC 15288 and other engineering standards

Source:  
Guide for ISO/IEC 15288  
(System Life Cycle  
Processes), WD3



# Best Practice Support for the Software Life Cycle Framework



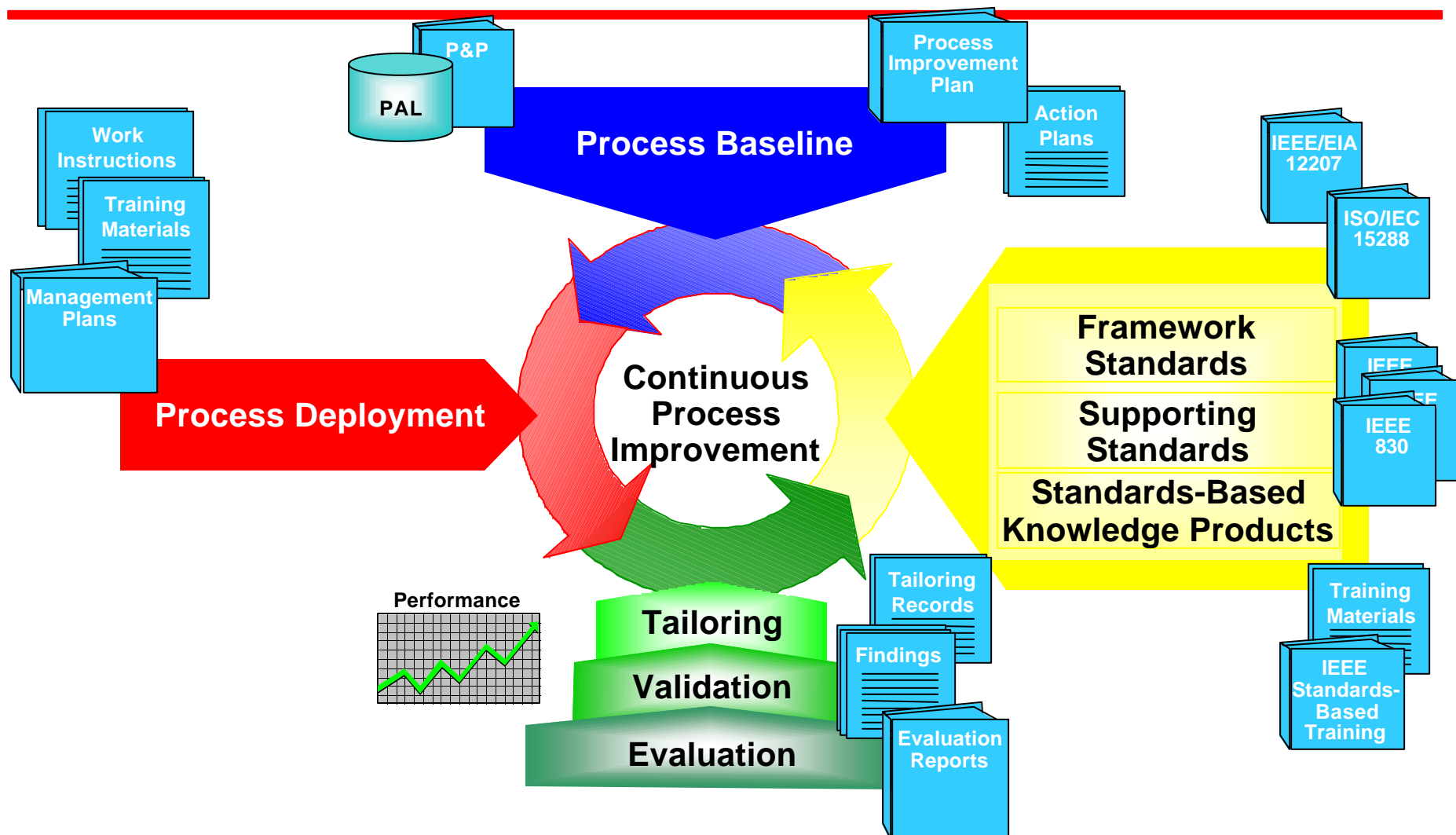
Table 1—Information item matrix

Information item(s)	IEEE/EIA 12207.0 Clause	Kind of documentation	IEEE/EIA 12207.1 Clause	References (See annex A.)
Acceptance strategy and conditions record	5.1.1.9	Record (5.4)	—	IEEE 1062
Acquisition plan	5.1.1.8	Plan	6.1	ASTM E731, E1206, IEEE 1062
Acquisition requirements record	5.1.2.1	Record (5.4)	—	IEEE 1062, 1220
Audit agenda record	6.7.1.4	Record (5.4)	—	—
Audit procedure	6.7.1.4	Procedure (5.3)	—	—
Change request	5.4.4, 5.5.1, 6.2.3	Request	6.2	—
Concept of operations description	5.1.1.1	Description	6.3	IEEE 1362, EIA/IEEE J-STD-016 F.2.1. Also see ISO 5806, 5807, 8631, 8790, and 11411 for guidance on use of notations.
Concept/need determination record	5.1.1.1	Record (5.4)	—	IEEE 1062, 1220
Database design description	5.3.5.3, 5.3.6.3, 5.3.7.1	Description	6.4	IEEE 1016, EIA/IEEE J-STD-016 G.2.3
Detailed design evaluation record	5.3.6.7	Record	6.6	—
Development process plan	5.3.1.4	Plan	6.5	ASTM E622, E1340, EIA/IEEE J-STD-016 E.2.1, IEEE 1074, 1074.1

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# Applying Best Practices





# CMMI<sup>SM</sup> SW/SE/IPPD v1.02

## Process Areas

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### *Process Management*

- Organizational Process Focus
- **Organizational Process Definition**
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

### *Project Management*

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- **Risk Management**
- Integrated Teaming
- Quantitative Project Management

### *Engineering*

- Requirements Management
- **Requirements Development**
- Technical Solution
- Product Integration
- Verification
- Validation

### *Support*

- Configuration Management
- **Process and Product Quality Management**
- Measurement and Analysis
- Decision Analysis and Resolution
- Organizational Environment for Integration
- Causal Analysis and Resolution



# Organizational Process Definition



## SP 1.1-1 Establish Standard Processes

- ◆ Establish and maintain the organization's set of standard processes

- EIA 632 - Processes for Engineering a System
- IEEE 1220 - IEEE Standard for Application and Management of the Systems Engineering Process

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 5 - System Life Cycle Processes
  - ◆ Annex D - Concepts
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Clause 5 - Primary Life Cycle Processes
  - ◆ Clause 6 - Supporting Life Cycle Processes
  - ◆ Clause 7 - Organizational Life Cycle Processes
  - ◆ Annex C - Guidance on Processes and Organizations





# Organizational Process Definition - 2



## SP 1.2-1 Establish Life-Cycle Model Descriptions

- ◆ Establish and maintain descriptions of the life-cycle process models approved for use in the organization

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 6 - System Life Cycle Stages
  - ◆ Annex B - Life Cycle Stages
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Clause 4 - Application
  - ◆ Annex E - Basic Concepts of IEEE/EIA 12207

- IEEE 1074, IEEE Standard for Developing Software Life Cycle Processes



# Organizational Process Definition - 3



## SP 1.3-1 Establish Tailoring Criteria and Guidelines

- ◆ Establish and maintain the tailoring criteria and guidelines for the organization's set of standard processes

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 2.3 - Tailored Conformance
  - ◆ Annex A - Tailoring
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Clause 4 - Application
  - ◆ Annex A - Tailoring
  - ◆ Annex B - Guidance on Tailoring



# Risk Management



## SP 1.1-1 Determine Risk Sources and Categories

- ◆ Determine risk sources and categories

## SP 1.2-1 Define Risk Parameters

- ◆ Define the parameters used to analyze and classify risks, and the parameters used to control the risk management effort

## SP 1.3-1 Establish a Risk Management Strategy

- ◆ Establish and maintain the strategy and methods to be used for risk management

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 5.4.6 - Risk Management Process
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Annex G - Life Cycle Process Objectives
    - Clause G.10 - Management Process
- IEEE 1540, Risk Management



# Risk Management



## SP 1.1-1 Determine Risk Sources and Categories

### Determine risk sources and categories

#### 5.4.6.3 Risk Management Process Activities

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Risk Management Process.

- a) Establish a systematic approach to risk identification, determining what could go wrong and would adversely affect the system and/or the organization.
- b) Define the risks in terms of their dimensions, e.g. technical, human, cost, schedule.
- c) Determine the likelihood of risk occurrence.
- d) Evaluate the impact of the risks and define their possible adverse consequences.
- e) Prioritize the risks in terms of their likelihood and consequence.

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## ISO/IEC 15288, System Life Cycle Processes

Clause 5.4.6 - Risk Management Process

EIA 12207.0, Software Life Cycle Processes

Annex G - Life Cycle Process Objectives

- Clause G.10 - Management Process

1540, Risk Management

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ISO/IEC CD 15288 FCD,  
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# Risk Management



SP  
and

- k) Determine the scope of risk management to be performed for the project;
- l) Identify risks to the project as they develop;
- ♦ m) Analyze risks and determine the priority in which to apply resources to mitigate those risks;
- n) Define, implement, and assess appropriate risk mitigation strategies;

SP

- ♦ o) Define, apply, and assess risk metrics to measure the change in the risk state and the progress of the mitigation activities;

analyze and classify risks, and  
the parameters used to control  
the risk management effort

## SP 1.3-1 Establish a Risk Management Strategy

- ♦ Establish and maintain the strategy and methods to be used for risk management

5288, System Life

Processes

5.4.6 - Risk Management

12207.0, Software

Life Processes

Annex G - Life Cycle Process  
Objectives

- Clause G.10 - Management Process

- IEEE 1540, Risk Management

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### 5.1.1.2 Establish the risk management process.

A description of the risk management process to be implemented shall be documented and promulgated. The description of the procedures that implement the risk management process should include:

- a) The frequency at which risks are to be reanalyzed and monitored
- b) The type of risk analysis required (quantitative and/or qualitative)
- c) The scales to be used to estimate risk likelihood and consequences and their descriptive and measurement uncertainty
- d) The types of risk thresholds to be used
- e) The types of measures used to track and monitor the state of the risks
- f) How risks are to be prioritized for treatment
- g) Which stakeholder(s) perspectives the risk management process supports
- h) The risk categories to be considered

### SP 1.3-1 Establish a Risk Management Strategy

- ◆ Establish and maintain the strategy and methods to be used for risk management

ISO/IEC 15288, System Life Cycle Processes

Clause 5.4.6 - Risk Management Process

IEEE/EIA 12207.0, Software Life Cycle Processes

Annex G - Life Cycle Process Objectives

- Clause G.10 - Management Process

### • IEEE 1540, Risk Management

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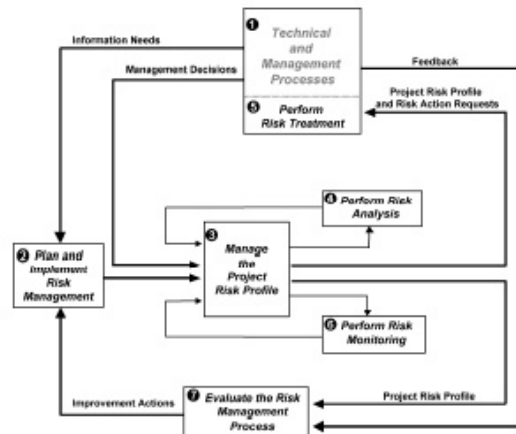


Figure 1—Risk management process model (informative)

The project risk profile information is continually updated and maintained through the “perform risk analysis” activity<sup>1</sup>, which identifies the risks, determines their likelihood and consequences, determines their risk exposures, and prepares risk action requests recommending treatment for risks determined to be above their risk threshold(s).

Treatment recommendations, along with the status of other risks and their treatment status, are sent to management for review<sup>2</sup>. Management decides what risk treatment is implemented for any risk found to be unacceptable. Risk treatment plans are created for risks that require treatment. These plans are coordinated with other management plans and other ongoing activities.

All risks are continually monitored until they no longer need to be tracked during the “perform risk monitoring” activity<sup>3</sup>. In addition, new risks are sought out.

Periodic evaluation of the risk management process is required to ensure its effectiveness. During the “evaluate the risk management process” activity<sup>4</sup>, information, including user and other feedback, is captured for improving the process or for improving the organization’s or project’s ability to manage risk. Improvements defined as a result of evaluation are implemented in the “plan and implement risk management” activity<sup>1</sup>.

The software risk management process is applied continuously throughout the product life cycle. However, activities and tasks of the risk management process interact with the individual risks in an iterative manner once the risk management process begins. For example, in the perform risk analysis activity<sup>1</sup>, a risk may be re-estimated several times during the performance of risk evaluation due to an increase in knowledge about the risk gained during the evaluation task itself. The risk management process is not a “waterfall” process.

# ment

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 5.4.6 - Risk Management Process
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Annex G - Life Cycle Process Objectives
    - Clause G.10 - Management Process
- IEEE 1540, Risk Management

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IEEE  
Std 1540-2001

IEEE STANDARD FOR SOFTWARE

## Annex A

(informative)

### Risk management plan

#### A.1 Purpose

The purpose of the risk management plan is to define how the risk management activities are implemented and supported during a project. The risk management plan is a key output of the planning process, and serves as the mechanism for implementing software risk management. The risk management plan would meet the intent of IEEE/EIA 12207.0-1996, 5.2.4.5 item k) and IEEE/EIA12207.1-1997, 6.11.3 item l) [B8] that require the inclusion of risk management information in the project management plan. A risk management plan that follows the outline below would also meet the intent of 4.5.4 of IEEE Std 1058-1998 [B7].

#### A.2 Risk management plan

The risk management process should result in a risk management plan that includes the sections shown in the outline below. If there is no information pertinent to a section or a required paragraph within a section, the management plan should contain the phrase, "This section is not applicable to this plan" below the section or paragraph heading, together with the appropriate reason for the omission. Additional information may be added if needed. Some of the risk management plan may appear in other documents. If so, reference to those documents should be made in the body of management plan.

The outline of the risk management plan is shown as follows:

1. Overview
  - 1.1 Date of Issue and Status
  - 1.2 Issuing Organization
  - 1.3 Approval Authority
  - 1.4 Updates
2. Scope
 

[Define the boundaries and limitations of risk on the project]
3. Reference Documents
4. Glossary
5. Risk Management Overview
 

[Describe the specifics of risk management for this project or organization's situation.]
6. Risk Management Policies
 

[Describe the guidelines by which risk management will be conducted.]
7. Risk Management Process Overview
8. Risk Management Responsibilities

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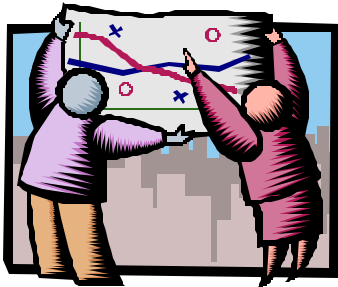
- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 5.4.6 - Risk Management Process
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Annex G - Life Cycle Process Objectives
    - Clause G.10 - Management Process
- IEEE 1540, Risk Management

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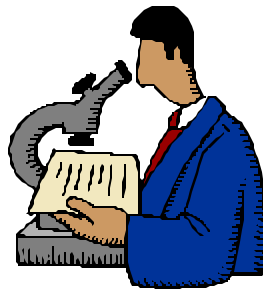


# 8 Steps to Success With Best Practice Information Aids

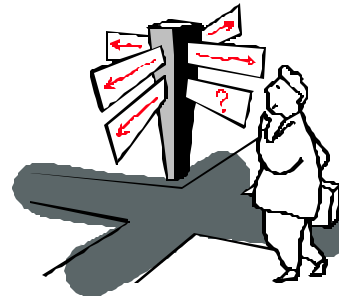
1 Understand your business processes



2 Look to the CMMI<sup>SM</sup> for Process Completeness



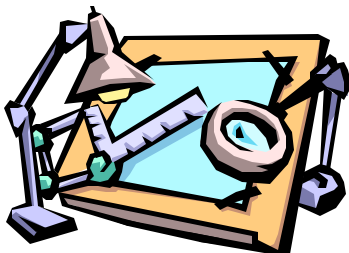
3 Look to Framework Standards for Life Cycle Definition



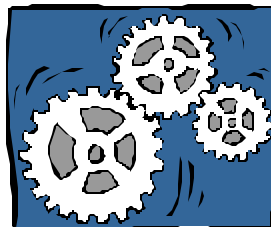
4 Look to Supporting Standards for Process Detail



5 Build Your Process Architecture



6 Execute Your Processes



7 Measure Your Results - Modify Processes as Necessary



8 Confirm Your Status With Independent Appraisals





# Requirements Development



## SP 2.1-1 Establish Product and Product Component Requirements

- ◆ Establish and maintain, from the customer requirements, product and product component requirements essential to product and product component effectiveness and affordability

## SP 2.2-1 Allocate Product Component Requirements

- ◆ Allocate the requirements for each product component

## SP 2.3-1 Identify Interface Requirements

- ◆ Identify interface requirements.

- ISO/IEC 15288, System Life Cycle Processes
  - ◆ Clause 5.5.2 - Stakeholder Requirements Definition Process
  - ◆ Clause 5.5.3 - Requirements Analysis Process
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ◆ Clause 5.3.2 - System requirements analysis
  - ◆ Clause 5.3.4 - Software requirements analysis
- IEEE 1233, Guide for Developing System Requirements Specifications
- IEEE 830, Recommended Practice for Software Requirements Specifications



# Process and Product Quality Management



## SP 1.1-1 Objectively Evaluate Processes

- ♦ Objectively evaluate the designated performed processes against the applicable process descriptions, standards and procedures

## SP 1.2-1 Objectively Evaluate Work Products and Services

- ♦ Objectively evaluate the designated work products and services against the applicable process descriptions, standards, and procedures

- ISO/IEC 15288, System Life Cycle Processes
  - ♦ Clause 5.3.6 - Quality Management Process
- IEEE/EIA 12207.0, Software Life Cycle Processes
  - ♦ Clause 6.3 - Quality Assurance Process
- IEEE 1220 - IEEE Standard for Application and Management of the Systems Engineering Process
  - ♦ Clause 4.13 - Quality Management
- IEEE 730, Standard for Software Quality Assurance Plans



# Next Steps



- The IEEE Software Engineering Standards Collection and the CMMI<sup>SM</sup>
  - ◆ Map Standards to the CMMI<sup>SM</sup>
  - ◆ Align the Collection with the CMMI<sup>SM</sup>
  - ◆ Update IEEE Standards-Based Training
- ISO/IEC Framework Standards and the CMMI<sup>SM</sup>
  - ◆ Harmonize the CMMI<sup>SM</sup> with the Systems and Software Life Cycle Framework Standards



# For more information . . .

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For IEEE Standards:

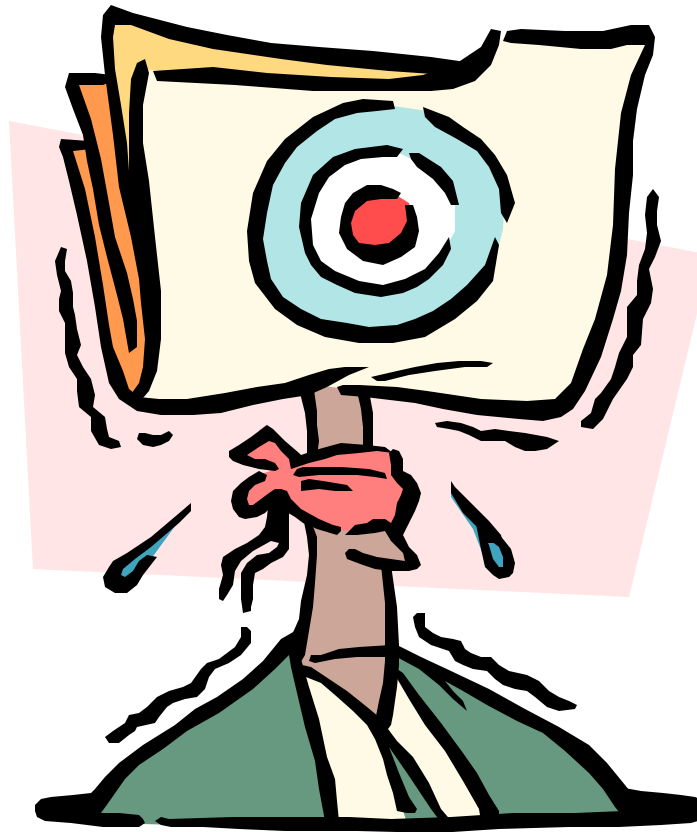
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<http://standards.ieee.org/catalog/>

For ISO/IEC Standards:

[http://saturne.info.uqam.ca/Labo\\_Recherche/Lrgl/sc7/](http://saturne.info.uqam.ca/Labo_Recherche/Lrgl/sc7/)

# Questions?





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IEEE/EIA Standard 12207.1-1997, *Industry Implementation of International Standard ISO/IEC12207:1995 — (ISO/IEC 12207) Standard for Information Technology —Software life cycle processes - Life Cycle Data*, Institute of Electrical and Electronics Engineers, Inc. New York, NY, 1998.



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- ISO/IEC CD 15288 FCD:2001, *Systems Engineering — System Life Cycle Processes*, ISO/IEC JTC1/SC7, 2001.
- ISO/IEC CD 15504-4: 2001 *Software Engineering — Process Assessment — Part 4: Guidance on use for Process Improvement and Process Capability Determination*, ISO/IEC JTC1/SC7, 2001.
- [Singh97] Raghu Singh, *An Introduction to International Standards ISO/IEC 12207, Software Life Cycle Processes*, 1997.